

ACUTE EFFECTS OF A LARGE BOLIDE IMPACT SIMULATED
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The global climatic effects of dust generated by the impact of a 10-km diameter bolide has been simulated using a globally-averaged climate model (1), and the generation and deposition rate of nitric acid created by impact-generated NO_x has been estimated (2) for large comet and moderate sized asteroid impactors. Neither study, however, explicitly accounted for the transport of dust and other trace materials by atmospheric circulations. Instead, these global studies attempted to bracket parametrically plausible spreading or transport rates. The goal of the present study is to use a global three-dimensional atmospheric circulation model developed for studies of atmospheric effects of nuclear war to examine the time evolution of atmospheric effects from a large bolide impact. The model allows for dust and NO_x injection, atmospheric transport by winds, removal by precipitation, radiative transfer effects, stratospheric ozone chemistry, and nitric acid formation and deposition on a simulated Earth having realistic geography. We assume a "modest" 2-km diameter impactor of the type that could have formed the 32-km diameter impact structure found near Manson, Iowa and dated at roughly 66 Ma. Such an impact would have created on the order of 5×10^{10} metric tons of atmospheric dust (about 0.01 g cm^{-2} if spread globally) and 1×10^{37} molecules of NO , or two orders of magnitude more stratospheric NO than might be produced in a large nuclear war. We ignore potential injections of CO_2 and wildfire smoke, and assume the direct heating of the atmosphere by impact ejecta on a regional scale is not large compared to absorption of solar energy by dust. We assume an impact site at 45°N in the interior of present day North America. Four 120-day simulations are performed varying each of two parameters: the season of the impact (January or July), and the initial impact distribution of dust and NO_x (1000-km or 3000-km radius from the impact site). The temporal and geographic evolution of land surface temperature effects, stratospheric ozone depletion, nitric acid formation and surface deposition will be discussed.

References:

- (1) Pollack, J.B., O.B. Toon, T.P. Ackerman and C.P. McKay, (1983) *Science*, **219**, pp. 287-289.
- (2) Prinn, R.G. and B. Fegley Jr., (1987) *Earth and Planetary Science Letters*, **83**, pp. 1-15.